

EXERCISES

For more practice, see *Extra Practice*.

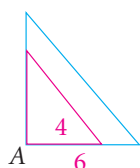
Practice and Problem Solving

A Practice by Example

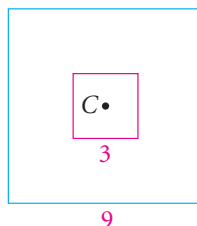
Example 1 (page 674)

The blue figure is a dilation image of the red figure. Describe the dilation.

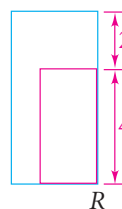
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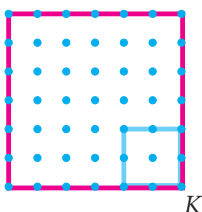
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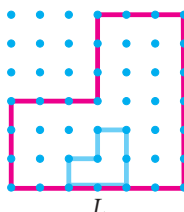
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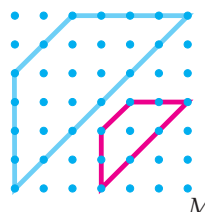
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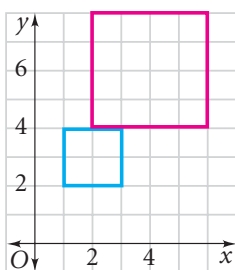
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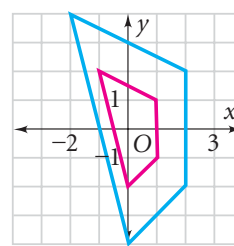
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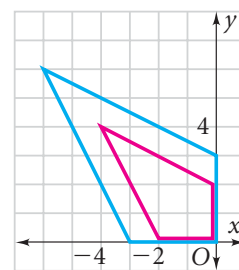
7.



8.



9.



Example 2 (page 675)

Model Railroads The table shows scales for different types of model railroads. For each model in Exercises 10–12, what would be the actual measurement?

10. An HO-scale tank car is 1.4 in. high.

11. An S-scale boxcar has length 8 in.

12. A model of an engineer in a G-scale model train layout is 3 in. tall.

13. A diesel engine is 60 feet long. How long is its O-scale model?

14. Actual railroad tracks are 4 ft 8.5 in. apart. How far apart are N-scale tracks?

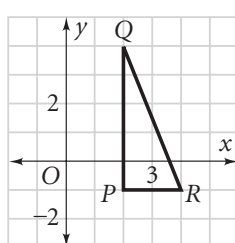
Model Railroad Scales

| Scale Name | Scale Ratio |
|------------|-------------|
| N | 1 : 160 |
| HO | 1 : 87.1 |
| S | 1 : 64 |
| O | 1 : 48 |
| G | 1 : 22.5 |

Example 3 (page 675)

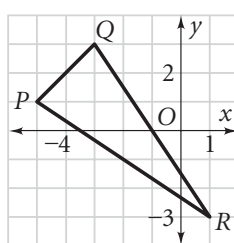
Use a matrix and scalar multiplication. Find the image of $\triangle PQR$ for a dilation with center $(0, 0)$ and the scale factor given. Draw the image.

15.



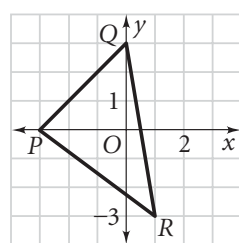
scale factor 3

16.



scale factor 10

17.



scale factor $\frac{3}{4}$

A dilation has center $(0, 0)$. Find the image of each point for the scale factor given.

18. $D(1, -5); 2$ 19. $L(-3, 0); 5$ 20. $A(-6, 2); 1.5$
 21. $T(0, 6); 3$ 22. $M(0, 0); 10$ 23. $N(-4, -7); 0.1$

Use scalar multiplication to find the image of $\triangle ABC$ for a dilation with center $(0, 0)$ and the scale factor given. Draw $\triangle ABC$ and its image.

24.

| | | | |
|--------------|---|-----|-----|
| | A | B | C |
| x-coordinate | $\begin{bmatrix} 1 & 3 & 5 \end{bmatrix}$ | | |
| y-coordinate | $\begin{bmatrix} 0 & 2 & 1 \end{bmatrix}$ | | |
| scale factor | 2 | | |
25.

| | | | |
|--------------|---|-----|-----|
| | A | B | C |
| x-coordinate | $\begin{bmatrix} -2 & 1 & 1 \end{bmatrix}$ | | |
| y-coordinate | $\begin{bmatrix} -2 & 1 & -1 \end{bmatrix}$ | | |
| scale factor | $\frac{1}{4}$ | | |
26.

| | | | |
|--------------|---|-----|-----|
| | A | B | C |
| x-coordinate | $\begin{bmatrix} 3 & -6 & 12 \end{bmatrix}$ | | |
| y-coordinate | $\begin{bmatrix} 1 & -9 & -3 \end{bmatrix}$ | | |
| scale factor | $\frac{1}{3}$ | | |
27.

| | | | |
|--------------|--|-----|-----|
| | A | B | C |
| x-coordinate | $\begin{bmatrix} -2 & -4 & -3 \end{bmatrix}$ | | |
| y-coordinate | $\begin{bmatrix} 0 & -3 & 0 \end{bmatrix}$ | | |
| scale factor | 5 | | |

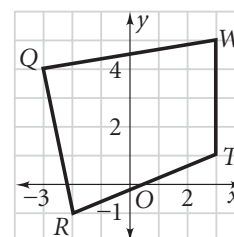
B Apply Your Skills

Use scalar multiplication to find the image of $QRTW$ for a dilation with center $(0, 0)$ and the scale factor given.

28. 3 29. 2 30. $\frac{1}{2}$ 31. $\frac{1}{4}$
 32. 0.6 33. 0.9 34. 10 35. 100



36. **Writing** An equilateral triangle has 4-in. sides. Describe its image for a dilation with scale factor 2.5. Explain.



Coordinate Geometry Graph $MNPQ$ and its image $M'N'P'Q'$ for a dilation with center $(0, 0)$ and the scale factor given.

37. $M(-1, -1), N(1, -2), P(1, 2), Q(-1, 3)$; scale factor 2
 38. $M(1, 3), N(-3, 3), P(-5, -3), Q(-1, -3)$; scale factor 3
 39. $M(0, 0), N(4, 0), P(6, -2), Q(-2, -2)$; scale factor $\frac{1}{2}$
 40. $M(2, 6), N(-4, 10), P(-4, -8), Q(-2, -12)$; scale factor $\frac{1}{4}$

41. **Open-Ended** Use the dilation command in geometry software or drawing software to create a design that involves repeated dilations. The software will prompt you to specify a center of dilation and a scale factor. Print your design and color it. Feel free to use other transformations along with dilations.

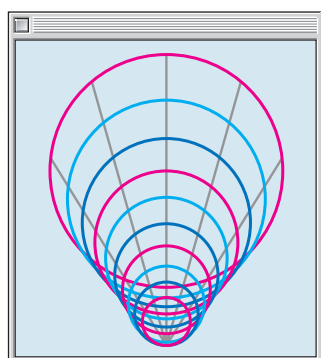
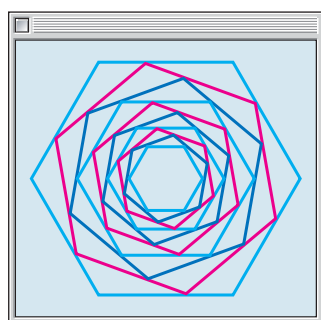


42. **Copy Reduction** Your copy of your family crest is 4.5 in. wide. You need a reduced copy for the front page of the family newsletter. The copy must fit in a space 1.8 in. wide. What scale factor should you use on the copy machine?

A dilation maps $\triangle HIJ$ to $\triangle H'I'J'$. Find the missing values.

- | | | |
|----------------------|---------------------|-----------------------|
| 43. $HI = 8$ in. | 44. $HI = 7$ cm | 45. $HI = \square$ ft |
| $IJ = 5$ in. | $IJ = 7$ cm | $IJ = 30$ ft |
| $HJ = 6$ in. | $HJ = \square$ cm | $HJ = 24$ ft |
| $H'I' = 16$ in. | $H'I' = 5.25$ cm | $H'I' = 8$ ft |
| $I'J' = \square$ in. | $I'J' = \square$ cm | $I'J' = \square$ ft |
| $H'J' = \square$ in. | $H'J' = 9$ cm | $H'J' = 6$ ft |

46. **Error Analysis** Brendan says that when a rectangle with length 6 cm and width 4 cm is dilated by a scale factor of 2, the perimeter and area of the rectangle are doubled. Explain what is incorrect about Brendan's statement.

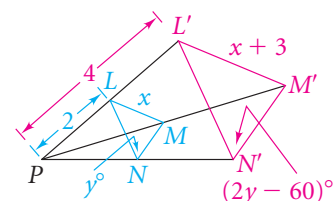


Exercise 41

The diagram at the right shows $\triangle LMN$ and its image $\triangle L'M'N'$ for a dilation with center P .

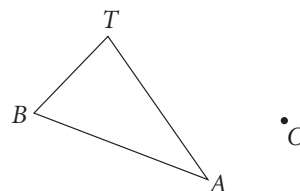
- 47. Algebra** Find the values of x and y .

- 48.** How does the area of $\triangle L'M'N'$ compare with the area of $\triangle LMN$?

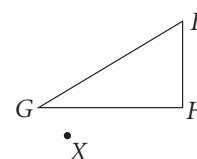


Copy $\triangle TBA$ and point O for each of Exercises 49–52. Draw the dilation image $\triangle T'B'A'$ for the given center and scale factor.

- 49.** center O , scale factor $\frac{1}{2}$
50. center B , scale factor 3
51. center T , scale factor $\frac{1}{3}$
52. center O , scale factor 2



- 53. Constructions** Copy $\triangle GHI$ and point X onto your paper. Use a compass and straightedge to construct the image of $\triangle GHI$ for a dilation with center X and scale factor 2.



Overhead Projection An overhead projector can dilate figures on transparencies.

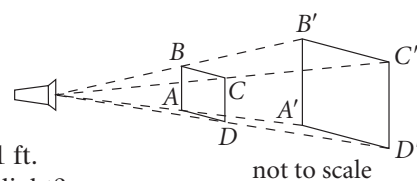
- 54.** A segment on a transparency is 2 in. long. Its image on the screen is 2 ft long. What is the scale factor of the dilation?
55. The height of a parallelogram on the transparency is 4 cm. The scale factor is 15. What is the height of the parallelogram on the screen?
56. The area of a triangle on the screen is 9 ft². The scale factor is 16. What is the area of the triangle on the transparency?

Write *true* or *false* for Exercises 57–61. Explain your answers.

- 57.** A dilation is an isometry. **58.** A dilation changes orientation.
59. A dilation with a scale factor greater than 1 is a reduction.
60. For a dilation, corresponding angles of the image and preimage are congruent.
61. A dilation image cannot have any points in common with its preimage.

Challenge

- 62.** A flashlight projects an image of rectangle $ABCD$ on a wall so that each vertex of $ABCD$ is 3 ft away from the corresponding vertex of $A'B'C'D'$. The length of \overline{AB} is 3 in. The length of $\overline{A'B'}$ is 1 ft. How far from each vertex of $ABCD$ is the light?



- 63. Critical Thinking** You are given \overline{AB} and its dilation image $\overline{A'B'}$ with A, B, A' , and B' noncollinear. Explain how to find the center of dilation and scale factor.

Coordinate Geometry In the coordinate plane you can extend dilations to include scale factors that are negative numbers.

- 64. a.** Graph $\triangle PQR$ with vertices $P(1, 2)$, $Q(3, 4)$, and $R(4, 1)$.
b. For a dilation centered at the origin with a scale factor of -3 , multiply the coordinates in part (a) by -3 . List the results as P' , Q' , and R' .
c. Graph $\triangle P'Q'R'$ on the same set of axes.



Need Help?

For Exercise 65(b), recall the meaning of reflection in a line.

65. a. A dilation with center at the origin and scale factor -1 (see Exercise 64) may be called a *reflection in a point*. For $\triangle PQR$ of Exercise 64, find the image $\triangle P'Q'R'$ for such a dilation.



- b. **Writing** Explain why the dilation described in part (a) may be called a *reflection in a point*. Extend your explanation to a new definition of point symmetry. Compare your new definition with the definition given on page 663.

66. **Constructions** Draw acute $\triangle ABC$. Construct square $DEFG$ so that \overline{DG} is on \overline{AC} , and E and F are on the other two sides of $\triangle ABC$. (Hint: First, try the special case with a right angle at A and use a dilation.)



Standardized Test Prep

Gridded Response

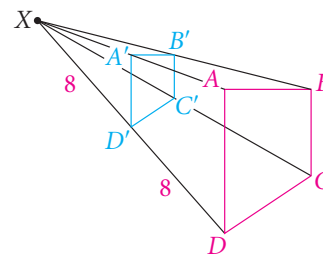
67. A dilation maps $\triangle ABC$ onto $\triangle A'B'C'$ with a scale factor of 0.3. If $A'B' = 3126$ m, what is AB in meters?
68. A dilation maps $\triangle CDE$ onto $\triangle C'D'E'$. If $CD = 7.5$ ft, $CE = 15$ ft, $D'E' = 3.75$ ft, and $C'D' = 2.5$ ft, what is DE in feet?
69. A dilation maps $\triangle XYZ$ onto $\triangle X'Y'Z'$. If $XY = 24$ m, $YZ = 29$ m, $X'Z' = 8.7$ m, and $Y'Z' = 29.145$ m, what is $X'Y'$ in meters?



Take It to the NET

Online lesson quiz at
www.PHSchool.com
Web Code: afa-1207

70. The center of dilation of quadrilateral $ABCD$ is point X , as shown at the right. The length of a side of quadrilateral $A'B'C'D'$ is what percent of the length of the corresponding side of quadrilateral $ABCD$?
71. A dilation maps $\triangle JKL$ onto $\triangle J'K'L'$. If $JK = 28$ cm, $KL = 52$ cm, $JL = 40.2$ cm, and $J'K' = 616$ cm, what is the scale factor?



Mixed Review

Lesson 12-6

Determine whether the polygons described could tessellate a plane.

72. congruent regular hexagons 73. squares and regular triangles
74. congruent regular octagons 75. congruent kite figures

Lesson 11-6

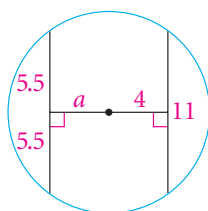
Give another description of each locus.

76. all points in a plane equidistant from three noncollinear points
77. all points in space 3 inches from a sphere with a 3-inch radius

Lesson 11-2

Find the value of a .

78.



79.

